

52, ne., at Kittyhawk, N. C. 25th, 60, e., at Tatoosh Island, Wash. 26th, 80, w., at Pikes Peak, Colo.; 72, se., at Tatoosh Island, Wash. 27th, 96, w., at Pikes Peak, Colo.; 54, w., at Cheyenne, Wyo.; 54, sw., at Winnemucca, Nev.; 52, sw., at Amarillo, Tex. 28th, 56, e., at Tatoosh Island, Wash.; 50, sw., at Amarillo, Tex. 29th, 84, sw., at Pikes Peak, Colo.; 59, sw., at Buffalo, N. Y. 30th, 58, nw., at Tatoosh Island, Wash.; 57, sw., at Colorado Springs, Colo.; 54, w., at Fort Canby, Wash. 31st, 60, w., at Huron, S. Dak.; 60, sw., at Idaho Falls, Idaho; 58, sw., at Colorado Springs, Colo.; 56, sw., at Amarillo, Tex.; 55, e., at Tatoosh Island, Wash.; 52, nw., at Moorhead, Minn.

LOCAL STORMS.

1st-2d.—At New London, Conn., light rain, with a southeast gale reaching a velocity of 50 miles per hour, prevailed during the 1st. At Southington, Conn., snow began 8 a. m., 1st, and changed to rain 1 p. m., with a heavy southeast gale at night; roads were badly washed and river meadows were flooded. At Blue Hill Observatory, Mass., the gale was reported the severest on record. At Billerica, Mass., a heavy southeast gale, with snow, sleet, and rain, prevailed. On the 2d the wind reached a velocity of 60 miles per hour from the southeast at Woods Holl, Mass., and a velocity of 52 miles per hour from the south was recorded at Boston, Mass. High wind caused damage of a minor character at Portland, Me.

5th.—In the evening high wind caused some damage at Chattanooga, Tenn. High northwest winds prevailed over Lake Michigan.

5-6th.—Northeast gales prevailed along the middle Atlantic and New England coasts, causing considerable damage to seaside property on Long Island and in New Jersey. On the southeast New England coast wind velocities of 60 to 70 miles per hour were reported. High northwest winds continued off the south New England, Long Island, and New Jersey coasts until the morning of the 7th.

8-9th.—High winds set in over the upper lakes. At Grand Haven, Mich., the wind caused an accumulation of ice which extended several miles from the shore. A northwest gale prevailed over Lake Erie during the 9th.

10-11th.—High northwest winds prevailed over the middle Atlantic and south New England states.

14-15th.—At Fort Canby, Wash., the wind increased in squalls from the southeast, and at 11.20 p. m., 14th, reached an extreme velocity of 110 miles. The gale continued until about noon of the 15th, and reached an extreme velocity of 120 miles per hour at 2.20 a. m., 15th. Several houses were blown down, trees were uprooted and broken off, and telegraph lines were prostrated. At Tatoosh Island, Wash., the maximum wind velocity was 72 miles on the 14th, and 76 miles per hour from the east on the 15th.

17th.—A destructive windstorm was reported at Highlands, about 50 miles east of Los Angeles, California.

19th.—At Jupiter, Fla., a thunderstorm prevailed from 1 to 3.04 p. m.; the wind reached a velocity of 33 miles per hour from the south, causing boats to drag their anchors.

24th.—At Key West, Fla., the barometer fell in the morning. From 1.30 to 2 p. m. the wind was variable. At 2 p. m. the wind began to increase from the north, and reached a velocity of 48 miles per hour at 3.05 p. m. From 2 to 3 p. m. the gale was attended by heavy rain and thunder at intervals.

30th.—At Heber, Utah, a thunderstorm prevailed from 10 p. m. until midnight. At 11 p. m. a violent storm from the southwest moved northeast over the town, leveling buildings, etc., in a path about 30 rods in width. On the 30th-31st a southwest gale damaged buildings at Montrose, Colo.

31st.—A northwest gale, with heavy snow and very low temperature, prevailed at Fort Buford, N. Dak. Westerly gales prevailed generally along the eastern Rocky Mountain slope and in the Northwest.

INLAND NAVIGATION.

ICE IN RIVERS AND HARBORS AND CLOSING OF NAVIGATION.

At Portland, Me., ice formed in the lower bay on the 14th for the first time since 1884; 19th, ice partly broken by warmer weather; navigation not interrupted. Great floes of ice interfered with navigation in Boston harbor from the 11th to the 13th. At Vineyard Haven, Mass., the harbor was frozen on the 12th; 17th, steamer "Monohansett" failed to get out of Edgartown harbor on account of ice; revenue cutter "Dexter" also ice bound; 20th, steamer "Nantucket" came through ice; 27th, steamer "Edgartown" broke through the ice. At New London, Conn., the Connecticut River was frozen over on the 11th; on the 16th navigation between New London and Norwich was closed. Ice in the rivers and harbor at New York interfered with navigation at intervals during the month. At Baltimore, Md., navigation, except for large steamers, was seriously interfered with by ice from the 17th to the 22d. On the latter-named date ice boats cut a channel for five delayed ocean steamers, and the ice blockade in Baltimore harbor was practically broken. On the 16th a large field of ice was encountered off Absecon, N. J. On the 17th field ice was reported about Barnegat, N. J., and heavy ice was encountered about the Delaware Breakwater and in the Delaware River. Heavy ice was reported in Delaware Bay until the last of the month. On the 22d Chesapeake Bay and tributaries were full of broken ice, and large quantities of ice were encountered off the New Jersey coast. A report from Norfolk, Va., dated the 24th, stated that navigation in that vicinity had been stopped for two weeks, large steamers, only, being able to cut their way through.

At New Brunswick, N. J., ice in the Raritan River broke the early morning of the 2d, and carried away a temporary bridge at the foot of Albany street; 20th, ice in the Raritan River 14 inches in thickness; ice broke in Raritan Bay and the lower Raritan River. At Penns Grove, N. J., the Delaware River was closed during the month, except the west channel which was kept open by iceboats. Heavy ice interfered with navigation at Philadelphia, Pa., on the 12th.

At Washington, D. C., navigation on the Potomac River was closed by ice from the 16th to the 28th. During the cold spell which began December 20, 1892, and continued with little interruption until about January 23, 1893, the mean temperature was 21.2°, and ice formed on the Potomac River to a thickness of 13.5 inches at a point in mid-stream about one-half mile above the Aqueduct bridge.

At Clarksville, Va., the Roanoke River was frozen from the 8th to the 26th; 27th to 31st, running ice at Clarksville. At Richmond, Va., the James River was frozen from the 7th to the 26th. A report from Kittyhawk, N. C., stated that Albemarle Sound and Bay were frozen over from the 3d to the 28th, suspending navigation. On the 18th and 19th traffic at Hatteras, N. C., was suspended on account of heavy ice. At Tarboro, N. C., the Tar River was frozen over on the 19th; from the 20th to the 23d persons were crossing on the ice. At Fayetteville, N. C., navigation on the Cape Fear River was stopped by ice on the 16th; 19th, river frozen over; 27th, ice broke up. The Pee Dee River was frozen over at Cheraw, S. C., from the 14th to the 26th. Floating ice was reported in the Santee River at Saint Stephens, S. C., on the 21st and

22d. At Resaca, Ga., floating ice was reported in the Oostanaula River from the 11th to 13th; 14th to 24th, river frozen over; 26th and 27th, floating ice. At Rome, Ga., the Oostanaula River was frozen on the 16th for the first time since January, 1857; 23d, ice 4 inches in thickness, and persons crossing; 25th, ice broke up. The Chattahoochee River was frozen over at Whitesburg, Ga., from the 19th to the 21st. At Cordova, Ala., floating ice was reported in the Big Warrior River on the 16th; 17th, river partly frozen. The Coosa River was frozen at Wilsonville, Ala., on the 20th.

Floating ice was reported in the Tennessee River at Florence, Ala., from the 11th to the 19th. At Charleston, W. Va., floating ice was reported in the Kanawha River on the 1st; 7th, river closed; 10th and 25th, boats broke through the ice. The Alleghany River closed at Freeport, Pa., on the 7th; 29th, ice running. On the 17th the south end of Seneca Lake, N. Y., was frozen over for the first time since 1885.

Monongahela River.—At Morgantown, W. Va., ice passed out on the 29th. Ice passed out at Fairmont on the 27th. At Lock No. 4, Pa., the river was frozen on the 1st; 3d and 4th, floating ice; 5th, river clear; 6th, frozen, but opened at 6 p. m.; 27th to 31st, floating ice. At Greensboro ice passed out on the 2d; 5th, river frozen; 29th, ice passed out.

Ohio River.—At Pittsburg, Pa., the river was frozen from the 11th to the 25th. At Parkersburg, W. Va., the river was frozen on the 1st; 2d, ice in Little Kanawha River broke and ran out; 5th, ice gorge above Baltimore and Ohio Railroad bridge broke at 5.30 p. m. and ran out; 6-7th, river frozen; 8th, ice running; 11th to 24th, river frozen; 29th, ice started to run, and on 31st was running out rapidly, with a rapid rise in the Ohio and Little Kanawha rivers. At Wheeling, W. Va., the river closed the night of the 10th; 29th, ice broke and gorged; 30th, gorge gave way. At New Cumberland, W. Va., the ice broke on the 3d; 11th, river closed; 30th, ice passed out. At Portsmouth, Ohio, the ice gorge broke the night of the 1st; 2d to 12th, heavy ice running; 13th to 29th, river closed; 29th, ice broke without causing material damage; 30th and 31st, heavy ice running.

At Cincinnati, Ohio, ice stopped running and the river was frozen on the 6th; 8th, ice gorge broke at 2 p. m.; the river was filled with a mass of grinding, crushing ice 4 to 10 feet in thickness, which caused great destruction to river property; 10th, river free of ice in front of the city, but a new gorge forming at the mouth of the Little Miami River; 14-15th, river frozen; 21st, river gorged at several points; 29th, ice broke at 7 a. m. At Shawneetown, Ohio, the river was frozen from the 13th to 26th, and opened on the 28th. At Maysville, Ky., the river gorged on the 10th and remained closed until the 29th; teams crossed on the ice. At Louisville, Ky., navigation was nearly suspended on account of heavy ice from the 1st to the 6th; 7th, river full of floating ice; 8-9th, river above the city gorged with ice; 10th, gorge above city broke and caused considerable damage to a coal fleet anchored at Louisville; 26th, ice allowed passage of ferryboats. On the 29th the ice passed out at Madison, Ind. At Paducah, Ky., floating ice was reported from the 4th to the 27th. At Mount Vernon, Ind., the river was closed on the 15th; 29th, ice broke.

Ice in the Sciota River at Circleville, Ohio, broke up on the 30th and passed out on the 31st. At Louisa, Ky., navigation on the Big Sandy River closed on the 1st; 3d, ice broke up; 5th, navigation closed; 30th, ice broke; 31st, navigation resumed.

Cumberland River.—At Nashville, Tenn., thin ice covered the river on the 13th for the first time since 1877; 16th, ice 2 to 3 inches in thickness covered the river; 24th, ice melting; 26th, river nearly clear of ice; 27th, river free of ice. On the 14th the river was full of slowly moving ice at Clarksville, Tenn. At Eddyville, Ky., the river was full of floating ice on the 13th and 14th.

Tennessee River.—On the 16th the river was frozen over opposite the southern part of Knoxville, Tenn., and a gorge formed below the Knoxville and Augusta Railroad bridge. At Chattanooga, Tenn., the river was partly frozen on the 11th; 13th and 14th, river full of ice; 16th, river almost frozen over; 17th-22d, river frozen; 23d-31st, running ice. The river was frozen over at Paducah, Ky., on the 16th.

Mississippi River.—At Saint Louis, Mo., the river was open on the 1st, and again closed on the 21st. At Cairo, Ill., the river was frozen from shore to shore on the 10th, and the Ohio River was full of floating ice; 14th, heavy ice ran out of the Ohio River. Heavy floating ice was reported at Memphis, Tenn., from the 12th to the 19th. At Helena, Ark., ice was reported in the river on the 15th; 23d, river clear of ice.

On the 22d the ice in the bay at Erie, Pa., was 17 to 18 inches in thickness. At Detroit, Mich., the river was frozen over and persons were crossing on the ice on the 10th. On the 23d persons and teams crossed on the ice from the mainland to many of the islands of the northwest part of Lake Erie for the first time in many years. A report from Saint Ignace, Mich., dated the 11th stated that an ice bridge had formed to Mackinac Island. At Grand Haven, Mich., the harbor was blocked by ice on the 17th, and two Milwaukee steamers were fast in the ice outside the harbor; 20th, one of the steamers, with the assistance of a tug, arrived at her dock; 21st, harbor again closed by ice; 26th, the other steamer entered the harbor with the assistance of a tug; 27th, a steamer left for Milwaukee, easterly winds having forced the ice out of the harbor; 31st, harbor open.

At Miles City, Mont., ice in the Yellowstone River broke up on the 6th. At The Dalles, Oregon, ice was reported in the Columbia River from the 1st to 3d, and 16th to 31st.

STAGE OF WATER IN RIVERS.

The following table shows the danger-points at the various river stations; the highest and lowest stages for the month, with the dates of occurrence; and the monthly ranges:

Heights of rivers above low-water mark, January, 1893.

| Stations. | Danger-point on gauge. | Highest water. | | Lowest water. | | Monthly range. |
|---------------------------|------------------------|----------------|-------|---------------|------------|----------------|
| | | Height. | Date. | Height. | Date. | |
| <i>Red River.</i> | <i>Feet.</i> | <i>Feet.</i> | | <i>Feet.</i> | | <i>Feet.</i> |
| Shreveport, La. | 29.9 | 29.1 | 1 | 16.5 | 31 | 12.6 |
| <i>Arkansas River.</i> | | | | | | |
| Fort Smith, Ark. | 22.0 | 8.6 | 4 | 2.7 | 22 | 5.9 |
| Little Rock, Ark. | 23.0 | 15.4 | 3.4 | 6.7 | 23, 24 | 8.7 |
| <i>Missouri River.</i> | | | | | | |
| Fort Buford, N. Dak. * | ..... | ..... | ..... | ..... | ..... | ..... |
| Pierre, S. Dak. * | 14.0 | ..... | ..... | ..... | ..... | ..... |
| Sioux City, Iowa * | 18.7 | ..... | ..... | ..... | ..... | ..... |
| Kansas City, Mo. * | 21.0 | ..... | ..... | ..... | ..... | ..... |
| <i>Mississippi River.</i> | | | | | | |
| Saint Paul, Minn. * | 14.0 | ..... | ..... | ..... | ..... | ..... |
| La Crosse, Wis. * | 11.8 | ..... | ..... | ..... | ..... | ..... |
| Dubuque, Iowa * | 16.0 | ..... | ..... | ..... | ..... | ..... |
| Davenport, Iowa * | 15.0 | ..... | ..... | ..... | ..... | ..... |
| Keokuk, Iowa * | 14.0 | ..... | ..... | ..... | ..... | ..... |
| Hannibal, Mo. * | 17.0 | ..... | ..... | ..... | ..... | ..... |
| Saint Louis, Mo. * | 30.0 | 7.5 | 16 | 2.8 | 7 | 4.7 |
| Cairo, Ill. | 40.0 | 16.8 | 4 | 5.2 | 28 | 11.6 |
| Memphis, Tenn. | 33.0 | 12.3 | 7 | 1.8 | 24 | 10.5 |
| Vicksburg, Miss. | 41.0 | 22.4 | 1 | 6.3 | 11 | 16.1 |
| New Orleans, La. | 13.0 | 8.1 | 14-16 | 4.0 | 31 | 4.1 |
| <i>Ohio River.</i> | | | | | | |
| Parkersburg, W. Va. * | 38.0 | ..... | ..... | ..... | ..... | ..... |
| Cincinnati, Ohio | 45.0 | 26.5 | 31 | 6.1 | 1 | 20.4 |
| Louisville, Ky. * | 24.0 | ..... | ..... | ..... | ..... | ..... |
| <i>Cumberland River.</i> | | | | | | |
| Nashville, Tenn. | 40.0 | 11.4 | 6 | 3.3 | 27 | 8.1 |
| <i>Tennessee River.</i> | | | | | | |
| Chattanooga, Tenn. | 33.0 | 7.1 | 31 | 2.9 | 12, 13, 23 | 4.2 |
| <i>Monongahela River.</i> | | | | | | |
| Pittsburg, Pa. | 29.0 | 14.7 | 30 | 1.4 | 1 | 13.3 |
| <i>Savannah River.</i> | | | | | | |
| Augusta, Ga. | 32.0 | 13.0 | 31 | 6.4 | 18, 19 | 6.6 |
| <i>Willamette River.</i> | | | | | | |
| Portland, Oregon | 15.0 | 8.6 | 1 | 1.4 | 30 | 7.2 |
| <i>Susquehanna River.</i> | | | | | | |
| Harrisburg, Pa. | 17.0 | 2.8 | 3-5 | 2.0 | 17-28 | 0.8 |
| <i>Alabama River.</i> | | | | | | |
| Montgomery, Ala. | 48.0 | 9.0 | 31 | 3.2 | 12 | 5.8 |
| <i>James River.</i> | | | | | | |
| Lynchburg, Va. * | ..... | ..... | ..... | ..... | ..... | ..... |

Heights of rivers—Continued.

| Stations. | Danger-point on range. | Highest water. | | Lowest water. | | Monthly range. |
|--------------------------|------------------------|----------------|-------|---------------|--------|----------------|
| | | Height. | Date. | Height. | Date. | |
| <i>Sacramento River.</i> | <i>Feet.</i> | <i>Feet.</i> | | <i>Feet.</i> | | <i>Feet.</i> |
| Red Bluff, Cal..... | | 11.9 | 27 | 3.5 | 23, 24 | 8.4 |
| Sacramento, Cal..... | | 26.0 | 1 | 19.5 | 26 | 6.5 |

* River frozen. † For 19 days. ‡ For 27 days. § For 22 days. ¶ For 17 days.

CLOSING AND OPENING OF NAVIGATION AT ALBANY, N. Y., 1832 TO 1892.

Chart IX, published with this issue of the REVIEW, presents diagrams, prepared by Mr. A. F. Sims, Observer, Weather Bureau, Albany, N. Y., showing the dates of closing and opening of navigation in the Hudson River at Albany, N. Y., the number of days in each winter, and the average number of days by decades of years, and for the period 1832 to 1892, navigation was closed by ice.

ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroras were reported as follows: 1st, Des Moines, Iowa. 5th, Minnesota City, Minn.; Newark, N. J. 6th, Cornish, Me.; Manchester, N. H.; Concord, Mass.; Sandy Lake Dam, Minn. 8th, Surface Creek, Colo.; Indian Stream, Me. 9th, Collegeville, Fergus Falls, and Maple Plain, Minn.; Gallatin, Grand Forks, Lakota, and Wild Rice, N. Dak.; Webster, S. Dak.; Crandon, Wis. 10th, Barron, Wis. 12th, Grand Haven, Mich.; Gallatin, N. Dak.; Barron, Wis. 13th, Stevenson, Conn. 14th, Grundy Center, Iowa; Cincinnati, Ohio. 17th, Chelsea and Woodstock, Vt. 18th, Houlton, Me.; Marquette, Mich.; Alexandria, Bingham Lake, and Fergus Falls, Minn.; Butternut, Medford, Shell Lake, and Valley Junction, Wis.

19th, Belfast, East Machias, and Houlton, Me.; Alpena and Marquette, Mich.; Bingham Lake, Minn.; Havre, Mont.; Napoleon, N. Dak.; Frankfort, Gary, and Webster, S. Dak.; Barron, Wis. 20th, Alexandria, Minn.; Bismarck and Napoleon, N. Dak. 21st, Alta, Iowa; Cornish, Farmington, Gardiner, Houlton, Indian Stream, and Presque Isle, Me.; Concord and Leominster, Mass.; Bingham Lake, Clear Lake, Fergus Falls, and Saint Olaf, Minn.; Glendive and Havre, Mont.; Bethlehem and Hanover, N. H.; Malone, N. Y.; Ashley,

Bismarck, Fort Buford, Grand Rapids, and Wild Rice, N. Dak.; Castlewood, S. Dak.; Chelsea, Northfield, and Hyde Park, Vt.; Grantsburg, Wis. 22d, Grand Rapids, N. Dak.; Castlewood, S. Dak. 24th, Placerville, Cal.; Cresco, Iowa; Savoy, Mass. 28th, Hastain, Mo. 31st, Mitchell, S. Dak.

THUNDERSTORMS.

Description of the more severe thunderstorms reported for the month is given under "Local storms."

Thunderstorms were reported as follows: East of the Rocky Mountains they were reported in the greatest number of states, 9, on the 28th; in 6 on the 19th; in 5 on the 11th; in 4 on the 12th, 18th, and 29th; in 3 on the 1st, 14th, 15th, and 27th; in 2 on the 9th, 17th, and 30th; and in 1 on the 7th, 16th, 24th, 26th, and 31st. No thunderstorms were reported on the 2d to 6th, 8th, 10th, 13th, and 20th to 23d.

East of the Rocky Mountains thunderstorms were reported on the greatest number of dates, 8, in Florida; on 7 in Mississippi; on 6 in Alabama and Georgia; on 5 in Louisiana; on 3 in Illinois, Indiana, Missouri, and Ohio; on 2 in Iowa, Michigan, and South Carolina; and on 1 in Connecticut, Kansas, North Carolina, South Dakota, Texas, and Wisconsin.

West of the Rocky Mountains thunderstorms were reported in California on the 27th, and in Utah on the 27th and 30th.

STATE WEATHER SERVICES.

[Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.]

The following extracts and summaries are republished from reports for January, 1893, of the directors of the various state weather services:

ALABAMA.

Temperature.—Maximum, 79, at Geneva, 2d; minimum, —8, at Newburg, 20th; greatest monthly range, 82, at Florence; least monthly range, 47, at Mobile, Tuscumbia, and Daphne.

Precipitation.—Greatest monthly, 6.98, at Maysville; least monthly, 0.37, at Tuscumbia.

Wind.—Prevailing direction, northwest.—P. H. Mell, Observer, Weather Bureau, Auburn, director.

ARIZONA.

Temperature.—Maximum, 80, at Fort Mohave, 15th, and at Rancho del Pueblo, 8d to 7th; minimum, 4, at Flagstaff, 18th and 20th; greatest monthly range, 59, at San Carlos; least monthly range, 35, at Oracle.

Precipitation.—Greatest monthly, 1.92, at Flagstaff; least monthly, 0.00, at Gila Bend, Palomas, Rancho del Pueblo, and Teviston.

Wind.—Prevailing direction, southwest.—W. Burrows, Observer, Weather Bureau, Tucson, director.

ARKANSAS.

Temperature.—The mean was 2.0 below the normal; maximum, 80, at Camden, 27th; minimum, —13, at Harrison, 19th; greatest monthly range, 83, at Harrison; least monthly range, 47, at Greenville, Miss.

Precipitation.—The average was 3.52 below the normal; greatest monthly, 4.68, at Greenville, Miss.; least monthly, 0.15, at Warm Springs.

Wind.—Prevailing direction, north.—M. F. Locke, Commissioner of Agriculture, Little Rock, director; F. H. Clarke, Local Forecast Official, Weather Bureau, assistant.

CALIFORNIA.

Temperature.—Maximum, 89, at Rialto, 6th; minimum, 9, at Susanville,

31st; greatest monthly range, 59, at San Jacinto; least monthly range, 16, at Williams.

Precipitation.—Greatest monthly, 11.70, at Glendora; least monthly, trace, at Needles.

Wind.—Prevailing direction, south.—J. A. Barwick, Observer, Weather Bureau, Sacramento, director.

COLORADO.

Temperature.—The mean was above the normal; maximum, 81, at Orchard, 5th; minimum, —16, at Breckenridge, 28th, and at Orchard, 31st; greatest monthly range, 97, at Orchard; least monthly range, 86, at Climax.

Precipitation.—Greatest monthly, 4.60, at Climax; least monthly, 0.00, at Orchard and Monte Vista.—J. J. Gilligan, Observer, Weather Bureau, Denver, director.

FLORIDA.

Temperature.—Maximum, 80, at Key West, 28th, and at Archer, 31st; minimum, 20, at Archer, 14th; greatest monthly range, 60, at Archer; least monthly range, 26, at Key West.

Precipitation.—Greatest monthly, 5.41, at Hypoluxo; least monthly, 0.48, at Saint Augustine.

Wind.—Prevailing direction, northwest.—E. R. Demain, Observer, Weather Bureau, Jacksonville, director.

GEORGIA.

The month was noted for the longest continued cold weather and the heaviest snowfall known in years.

Temperature.—Maximum, 78, at Darien, 2d; minimum, —1, at Adairsville, 21st; greatest monthly range, 69, at Adairsville; least monthly range, 47, at Columbus.